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High mountain climate in Northern Spain between 155 and 85 ka BP

M. B. Muñoz- García (1), J. Martín-Chivelet (1), C. Rossi (2), D. C. Ford (3), H. P. Schwarcz (3)

(1) Dpto. Estratigrafía, Fac. CC. Geológicas, Universidad Complutense de Madrid, Ciudad Universitaria, 28040, Madrid, Spain

(2) Dpto. Petrología y Geoquímica, Fac. CC. Geológicas, Universidad Complutense de Madrid, Ciudad Universitaria, 28040, Madrid, Spain

(3) School of Geography and Geology, McMaster University, Hamilton, Ontario, L8S 4M1, Canada

A contribution to the timing and structure of the high mountain climate in the Iberian Peninsula during MIS-5 is presented in an interdisciplinary study (isotopic and petrographic) of three speleothems from Cueva del Cobre, a cave located in the Cantabrian Mountains (Northern Spain).

The only known entrance of the cave is at ∼1600 m above the sea level. The studied stalagmites were sampled more than a kilometer away from the entrance and ∼100 m below the local land surface, which corresponds to a till-covered Pleistocene glacial valley at ∼1800 m above the sea level. This area is ∼60 km distant from the Bay of Biscay, but quite isolated from marine influences by the mountain range. The estimated mean annual temperature of the area varies between ∼6.0ºC at 1600 m a.s.l. and 4.7ºC on the surface above the cave. Estimated mean annual precipitation exceeds 1800 mm.

The existence of isotopic equilibrium during the growth of the three stalagmites has been checked (appropriate Hendy tests and low r^2 for δ^{18}O-δ^{13}C covariation along the growth axes). The paleoclimatic interpretation is based on eight TIMS U series dates, 263 oxygen and carbon isotopic analyses and the study of 112 thin sections. Relative changes in paleotemperatures have been deduced from the δ^{18}O record (temporal resolution between 170 and 450 years) and general humidity from the speleothems

growth rates. Other climate features such as seasonality or interannual variability have been described according to the petrographic record.

From the results, we have placed the date of glacier ice retreat (related to Termination II) in this area around ∼157 to 152 ka BP. A warmer climate was probably present from ∼150 ka BP but the Eemian has been defined as the most stable part of this period, between ∼138 and 117 ka BP. The main features of this interval in the area are low interannual variability, moderate seasonality, slightly higher temperatures than present ones, at least during the Eemian Optimum (around 134-133 ka BP), and notably drier conditions than today. Therefore, the duration of this interglacial period in the studied area defined according to climate stability is ∼21 ka, equivalent to those defined in other continental or ice records such as Devils Hole (∼22 ka) and Vostok (∼19 ka).

Some instability in the dripping conditions is noticed in the petrographic record following ∼122 ka BP. The instability of the speleothem feedwaters increases until ∼117, where we have placed the Eemian-Lower Weichselian boundary. Some temperature variations can be correlated with MIS-5d to MIS-5a, and the end of the record at ∼85 ka BP may be related to the environmental changes leading up to the Lower-Middle Weichselian transition, approximately equivalent to the onset of MIS-4.

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